



U.S. Patent Application Serial No. 10/827,089  
Filed: April 19, 2004  
Inventor: James Wagner Larsen  
For: Systems and Methods Useful For Detecting Presence  
And/Or Location Of Various Materials  
Attorney: James L. Ewing, IV  
Telephone: 404.315.6494  
Attorney Docket No. 14088/299978

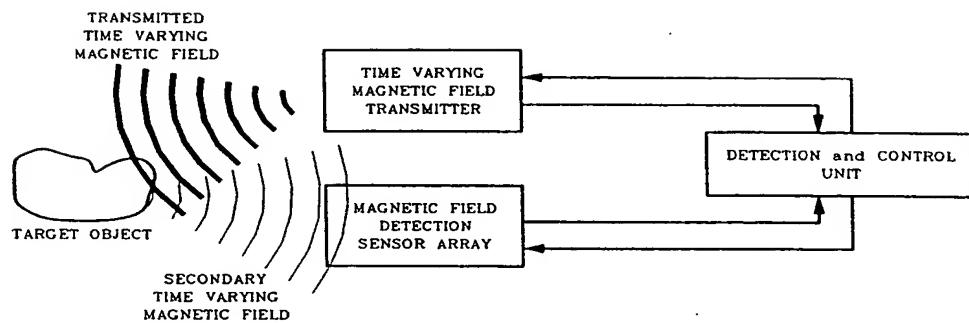


FIGURE 1-1 SYSTEM BLOCK DIAGRAM

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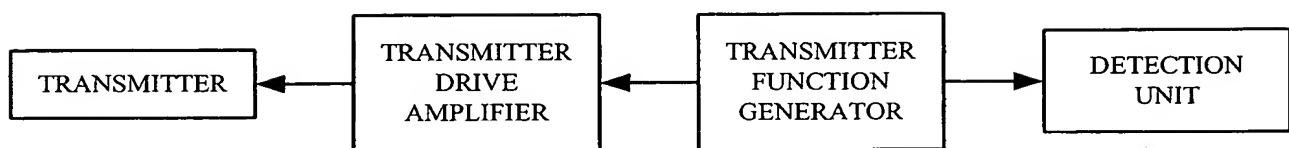


FIGURE 1-2  
TRANSMITTER WITH KNOWN OUTPUT FUNCTION

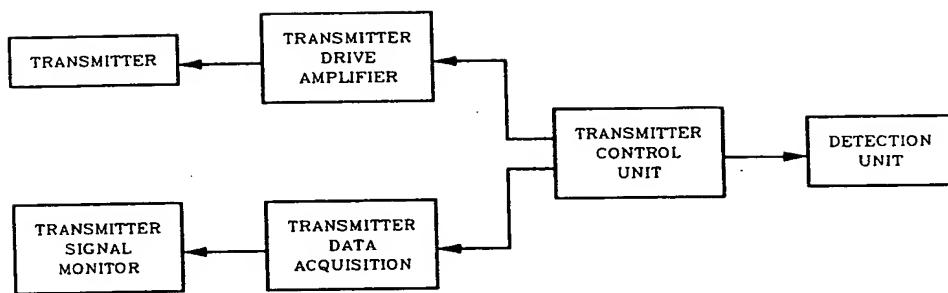


FIGURE 1-3  
TRANSMITTER WITH MAGNETIC FIELD MONITOR

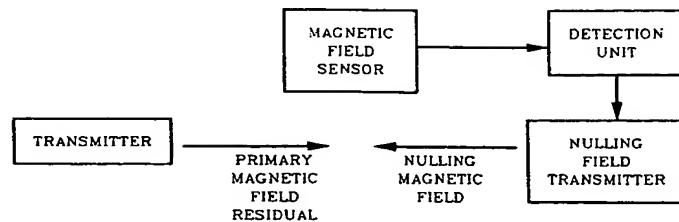


FIGURE 1-4A  
RESIDUAL MAGNETIC FIELD NULLING  
USING A NULLING MAGNETIC FIELD

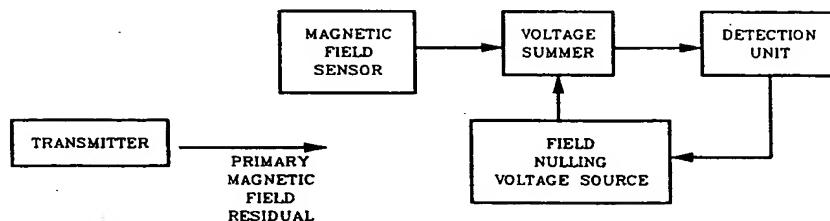


FIGURE 1-4B  
VOLTAGE NULLING OF RESIDUAL FIELD SENSOR OUTPUT

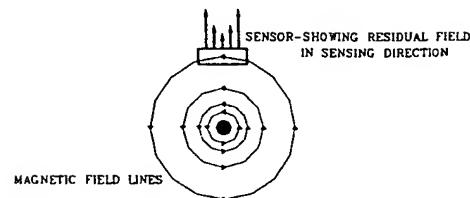


FIGURE 1-5A  
TRANSMITTER COIL CROSS SECTION FOR SINGLE WIRE COIL  
SHOWING SENSOR POSITION AND RESIDUAL FIELD

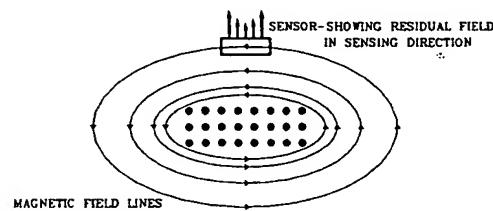


FIGURE 1-5B  
TRANSMITTER COIL CROSS SECTION FOR NORMAL RECTANGULAR COIL  
SHOWING SENSOR POSITION AND RESIDUAL FIELD

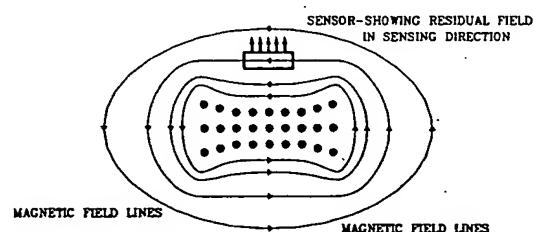


FIGURE 1-5C  
TRANSMITTER COIL CROSS SECTION FOR SHAPED COIL  
SHOWING SENSOR POSITION AND RESIDUAL FIELD

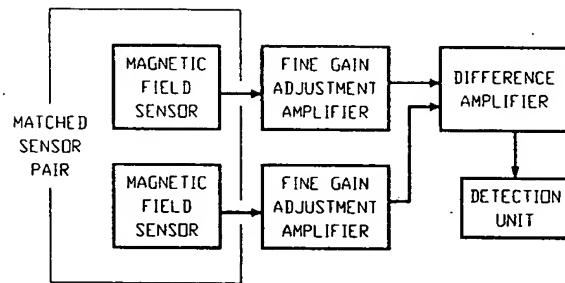


FIGURE 1-6  
GRADIENT SENSING USING A MATCHED SENSOR PAIR

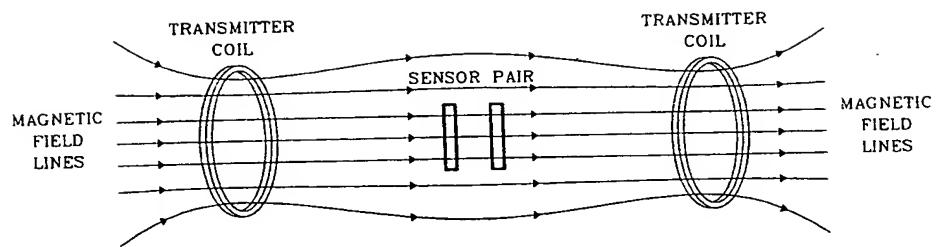


FIGURE 1-7  
SENSOR PAIR CALIBRATION  
USING TWO TRANSMITTER EQUAL COILS

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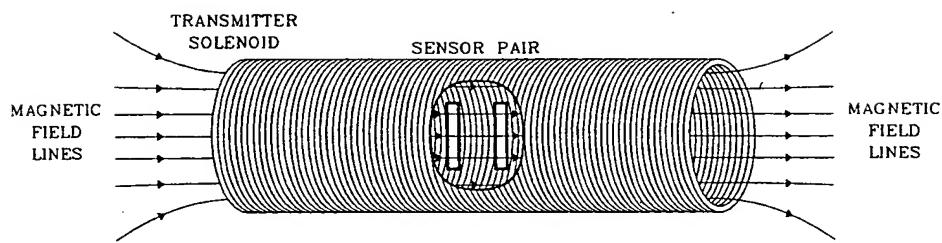


FIGURE 1-8  
SENSOR PAIR CALIBRATION  
USING A LARGE SOLENOID COIL

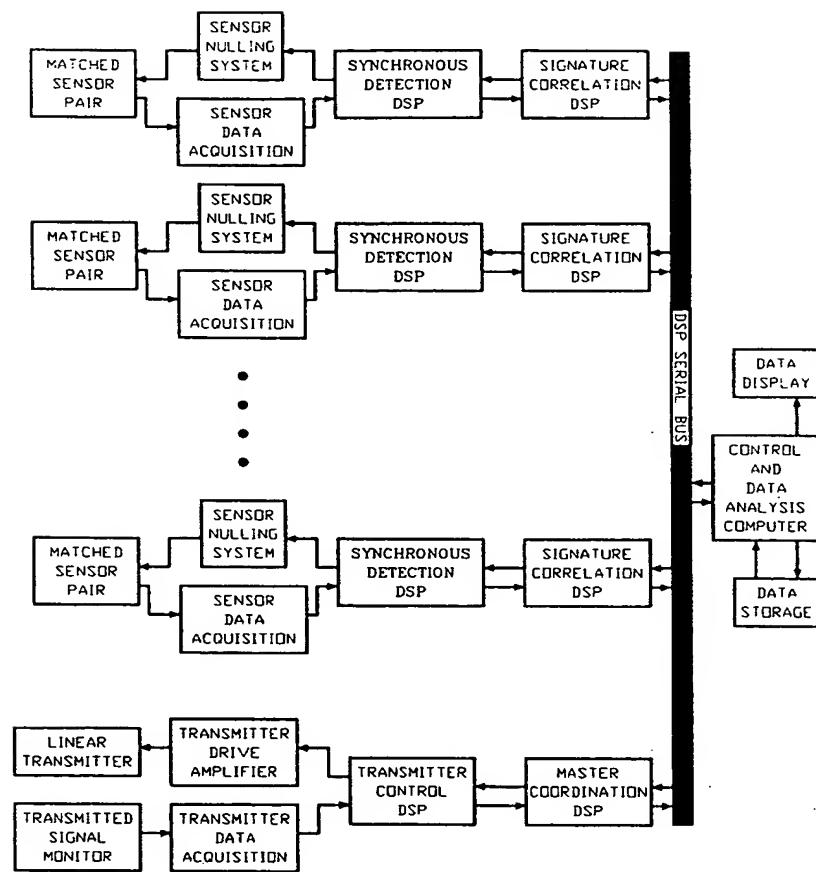


FIGURE 1-9  
SYSTEM WITH MULTIPLE SENSOR PAIRS  
AND SYNCHRONOUS DETECTION  
BASED ON DSP PROCESSORS

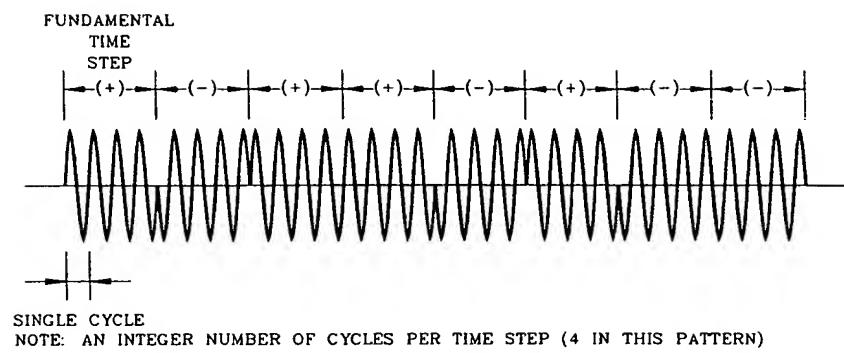


FIGURE 1-10  
AN 8 SECTION (+ - + + - + - -)  
TIME ENCODED WAVEFORM

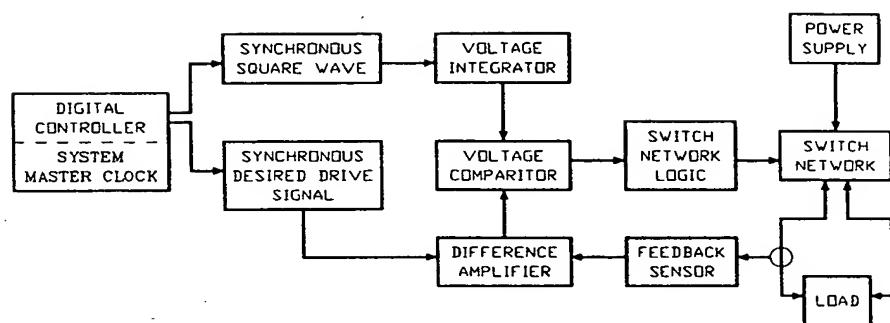


FIGURE 2-1  
SYNCHRONOUS PULSE WIDTH MODULATION AMPLIFIER

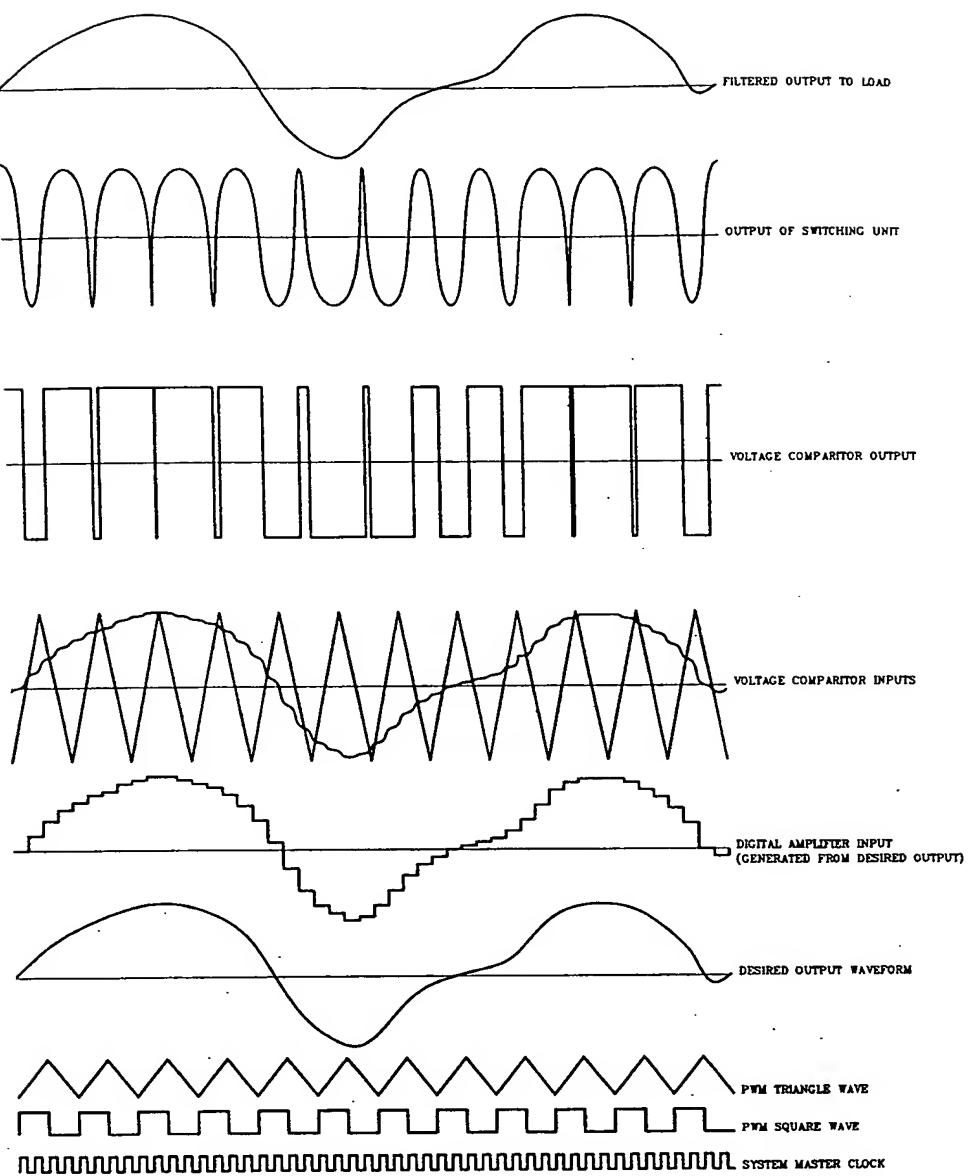


FIGURE 2-2  
TYPICAL PULSE WIDTH MODULATION WAVEFORMS

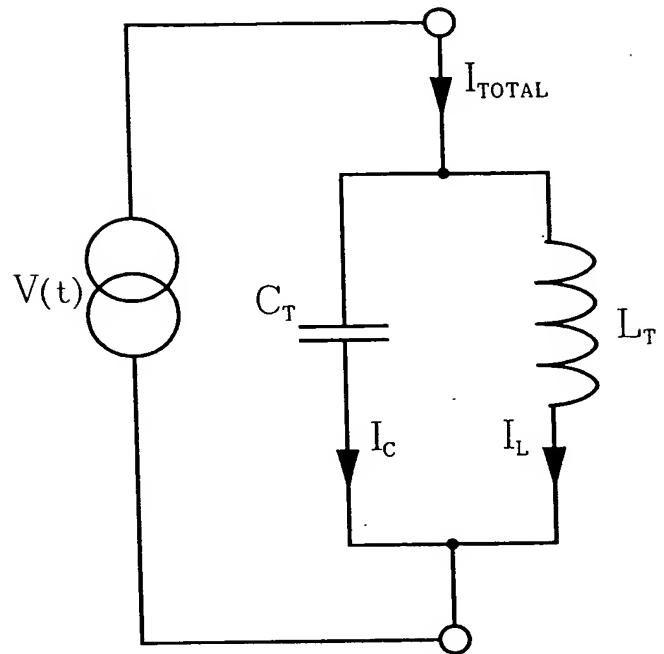


FIGURE 3-1  
STANDARD TANK CIRCUIT

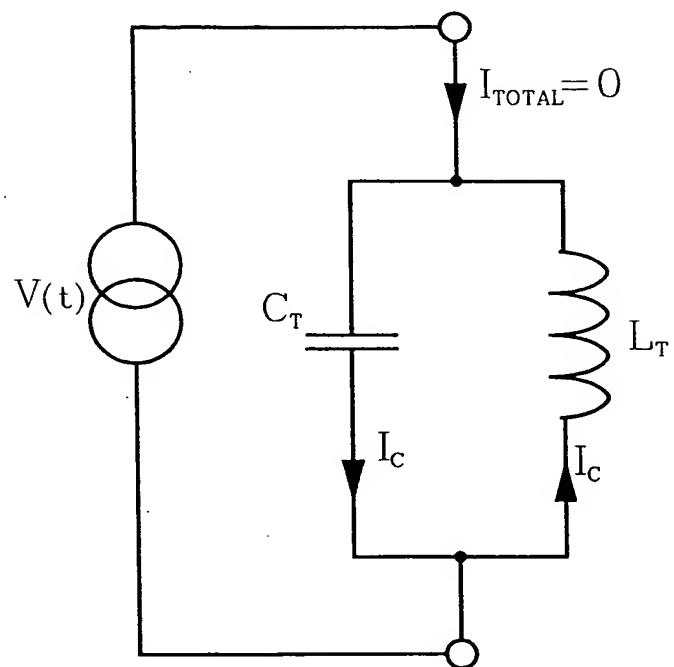


FIGURE 3-2  
AT RESONANCE TOTAL CURRENT IS ZERO  
BECAUSE,  $I_L = -I_C$

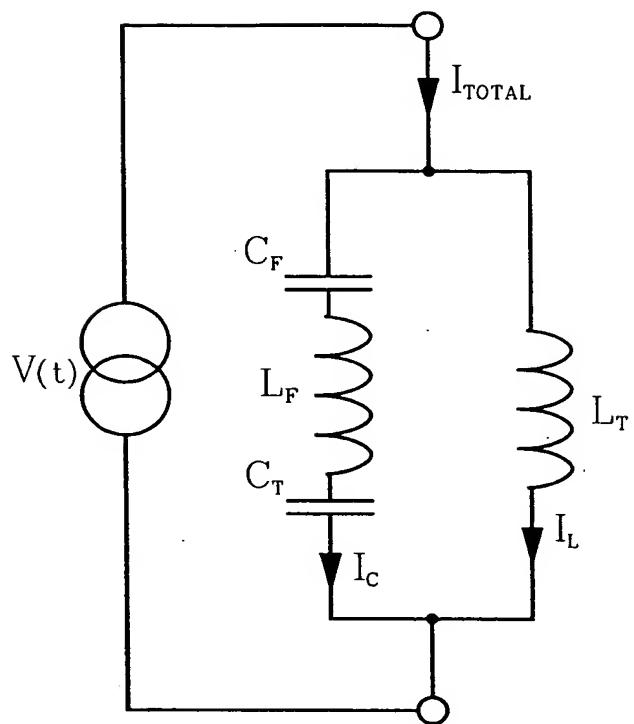


FIGURE 3-3  
TANK CIRCUIT WITH SERIES CAPACITOR  
AND INDUCTOR TO LIMIT OFF RESONANCE  $I_C$

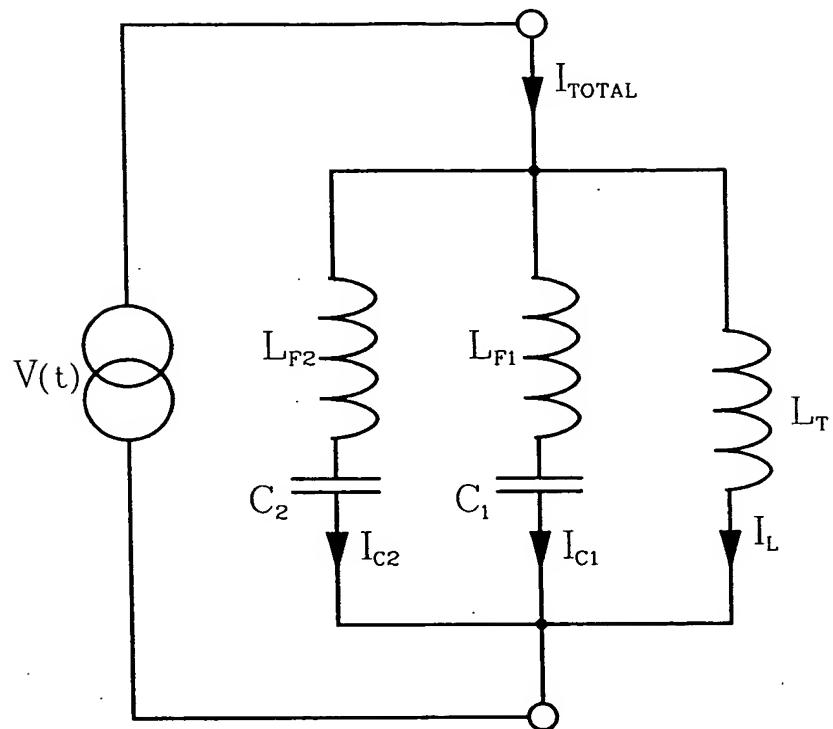


FIGURE 3-4  
TANK CIRCUIT WITH TWO RESONANCES

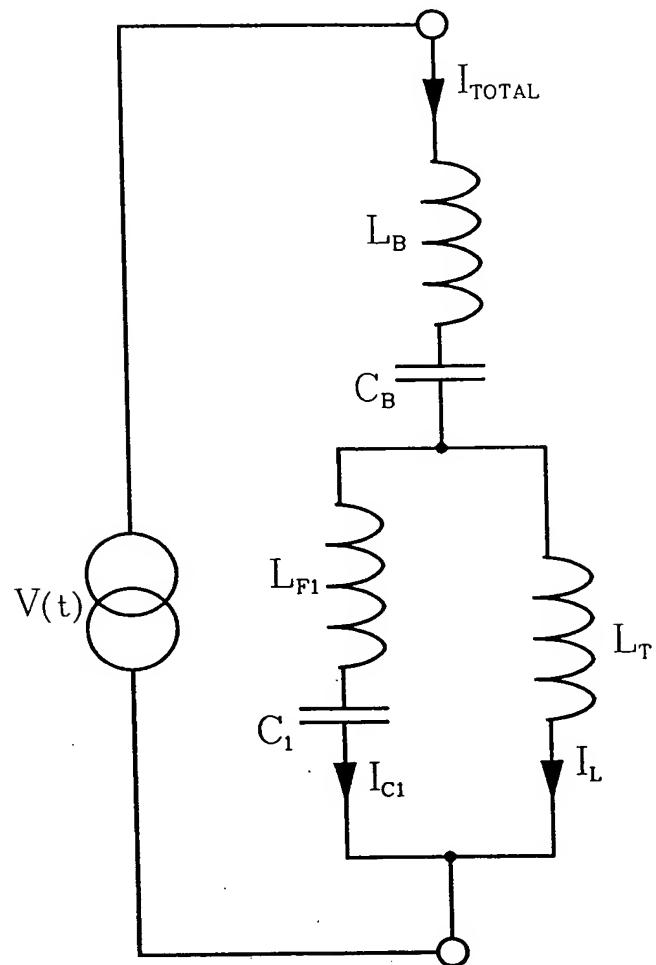


FIGURE 3-5  
TANK CIRCUIT WITH  
SINGLE FREQUENCY BLOCKING CIRCUIT

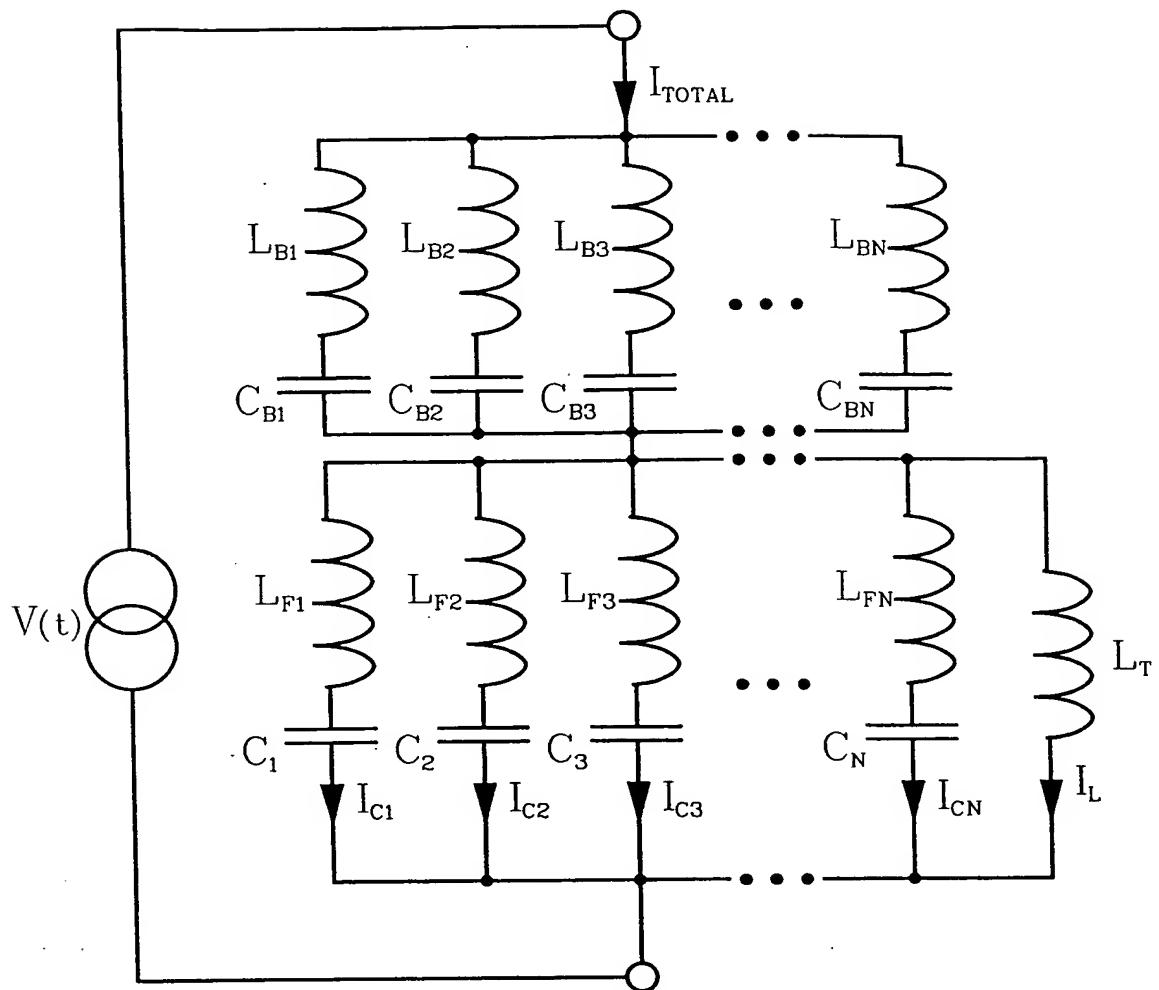


FIGURE 3-6  
TANK CIRCUIT WITH  
A MULTIPLE FREQUENCY BLOCKING CIRCUIT  
FOR N DISCRETE FREQUENCIES

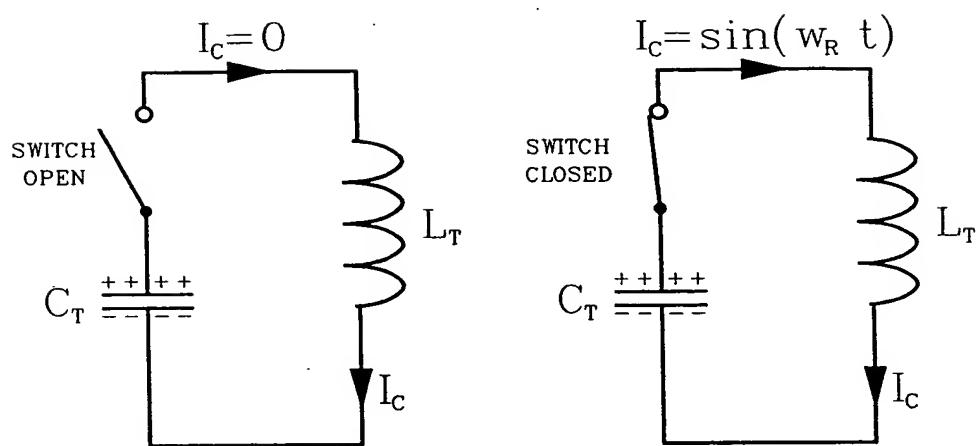


FIGURE 4-1  
WHEN SWITCH IS CLOSED CIRCUIT OSCILLATES  
AT RESONANT FREQUENCY,  $w_R$

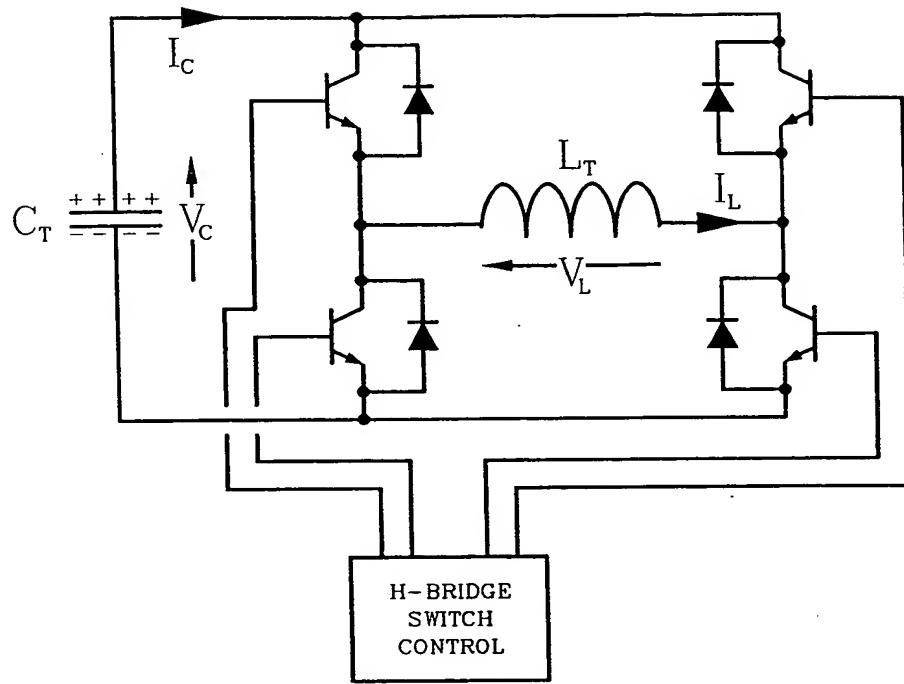


FIGURE 4-2  
AN H-BRIDGE SWITCH NETWORK  
CONNECTINT THE CHARGED CAPACITOR  
TO THE LOAD COIL

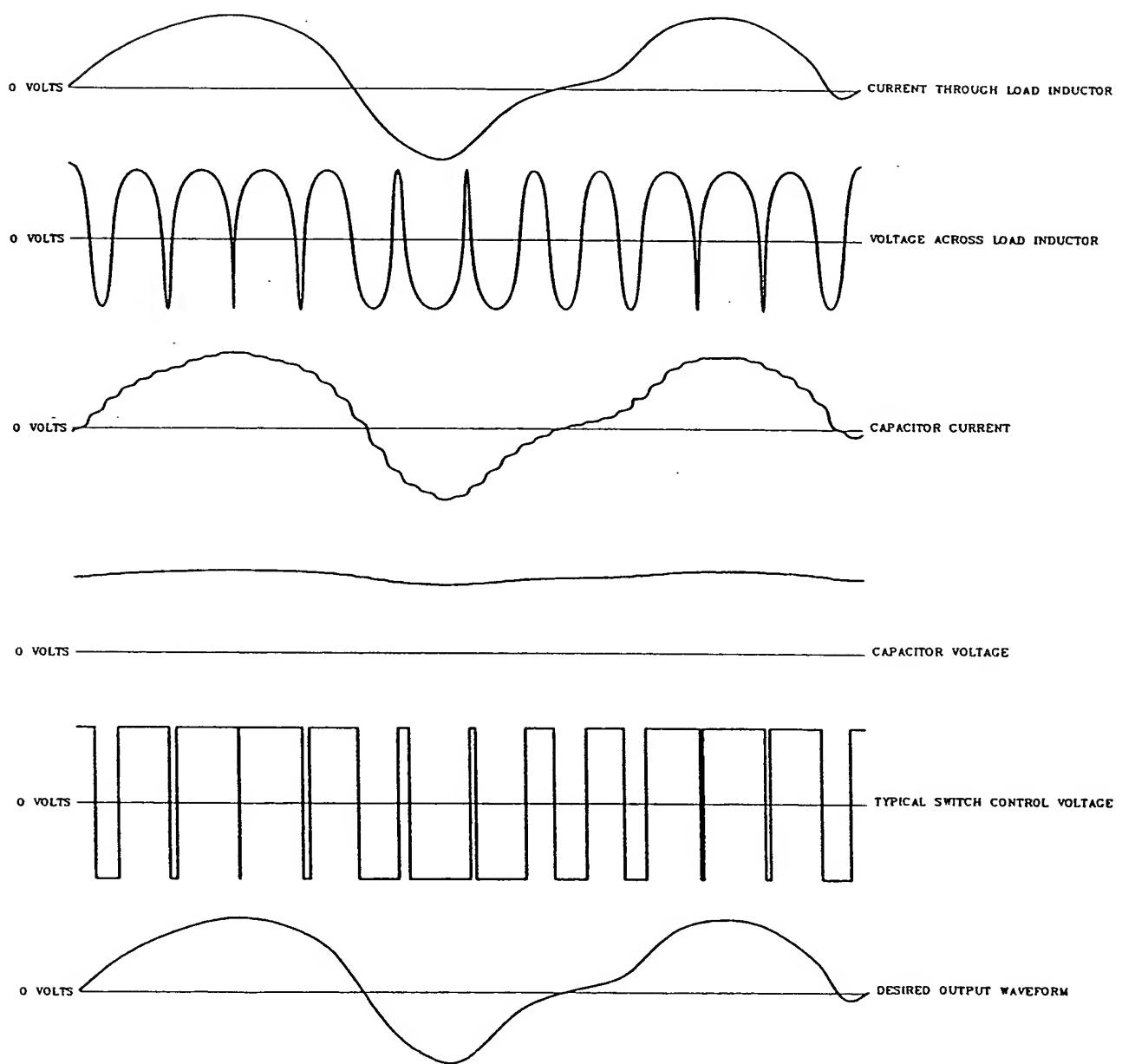


FIGURE 4-3  
SWITCHED CAPACITOR CIRCUIT WAVEFORMS

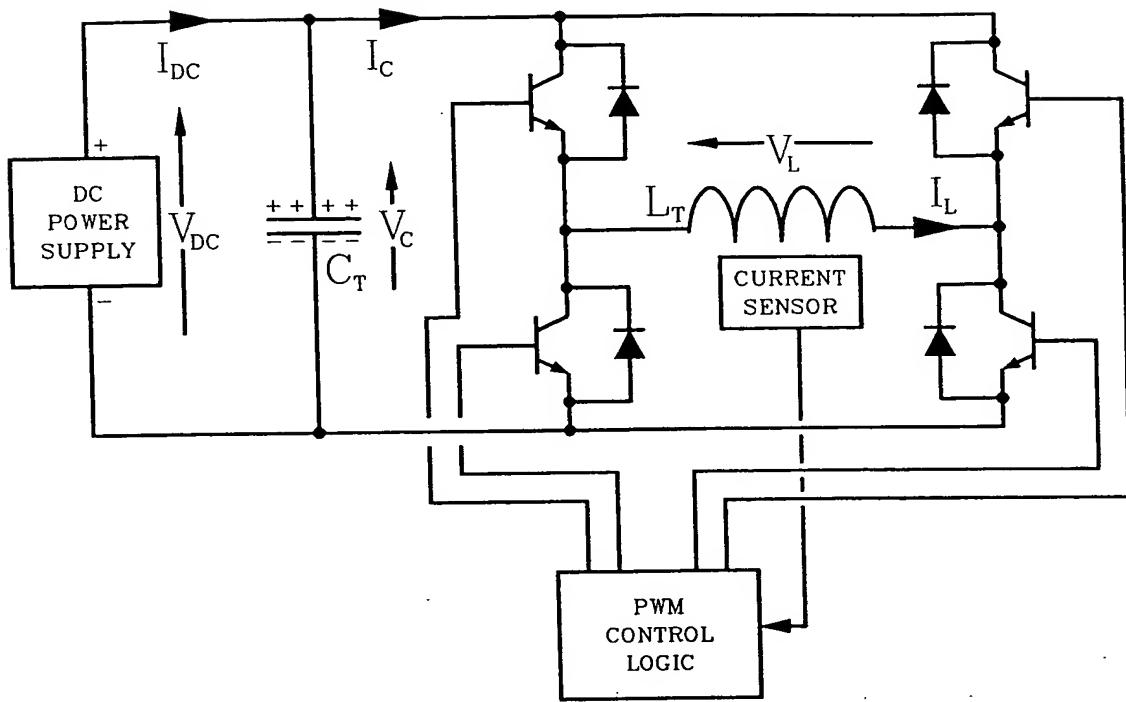


FIGURE 4-4  
PULSE WIDTH MODULATED  
SWITCHED CAPACITOR RESONATOR

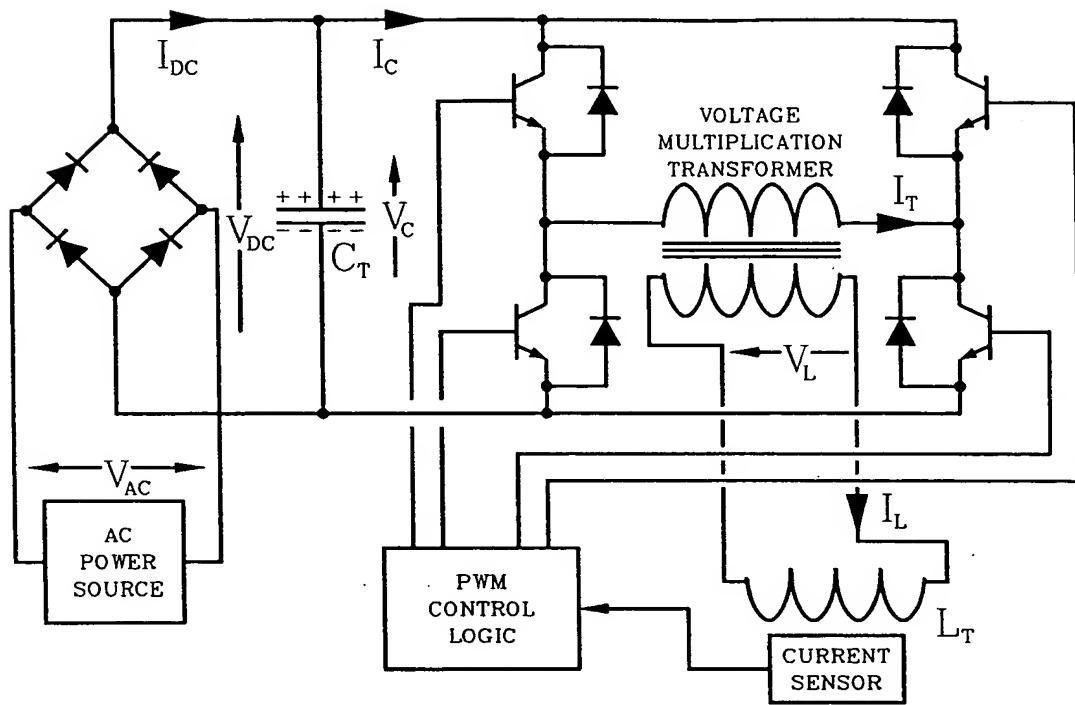


FIGURE 4-5  
SWITCHED CAPACITOR RESONATOR  
WITH INTEGRAL SWITCHING POWER SUPPLY

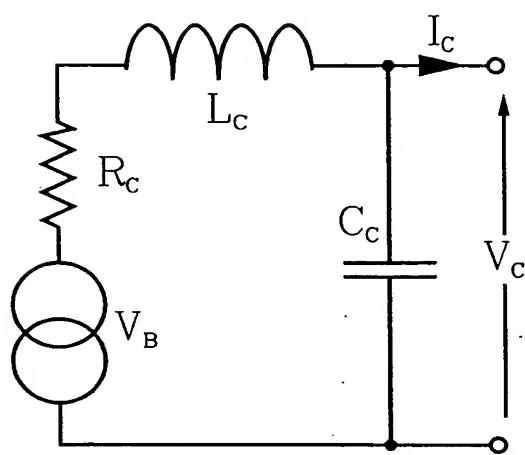


FIGURE 5-1  
SENSE COIL EQUIVALENT CIRCUIT

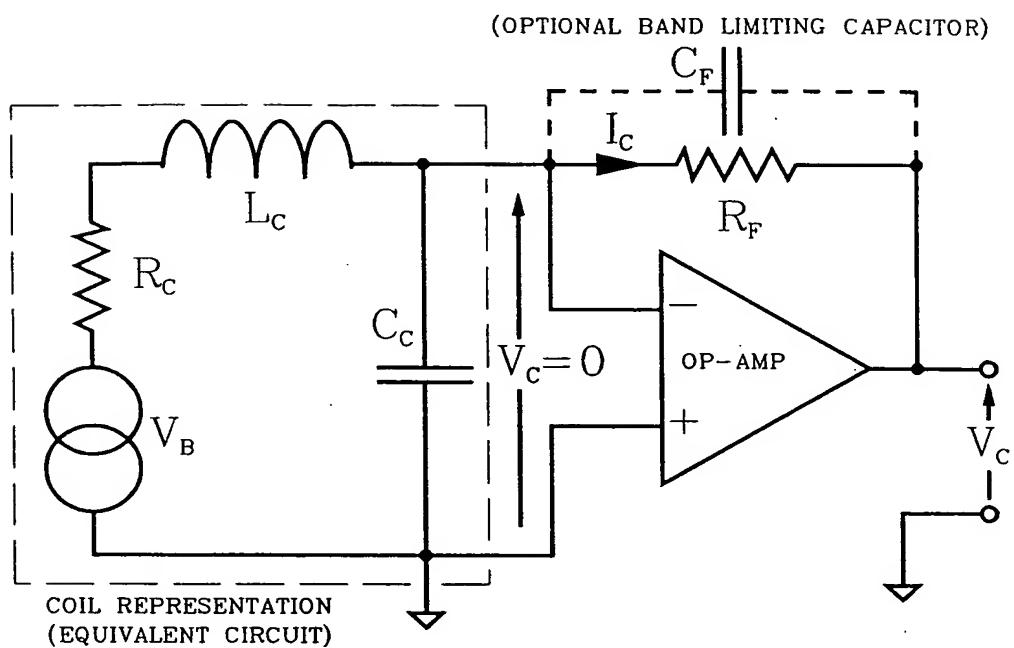


FIGURE 5-2  
OPERATIONAL AMPLIFIER BASED  
VOLTAGE TO CURRENT CONVERSION CIRCUIT

SENSITIVITY FOR #32 WIRE WITH Rf+10MOhm

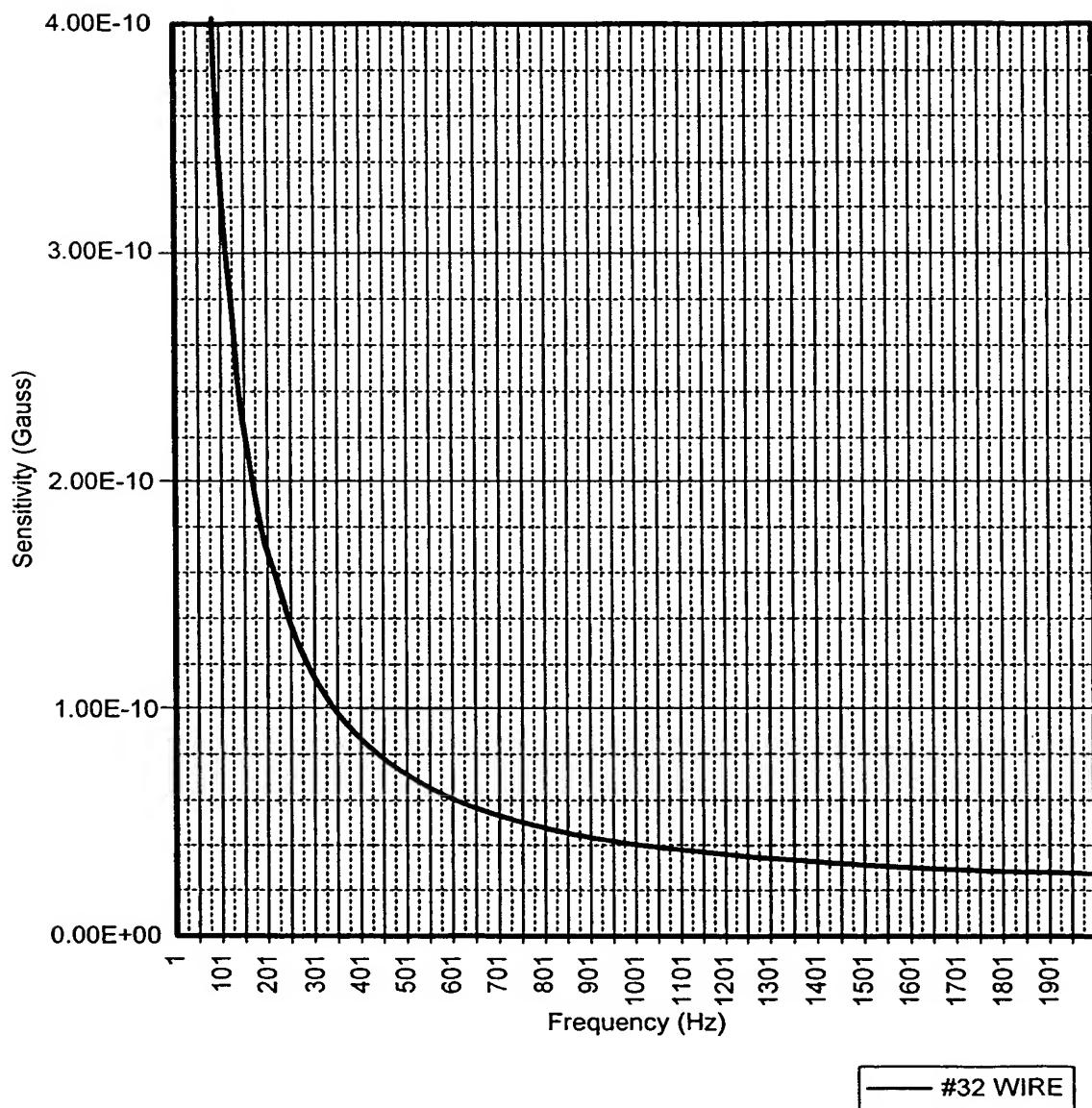
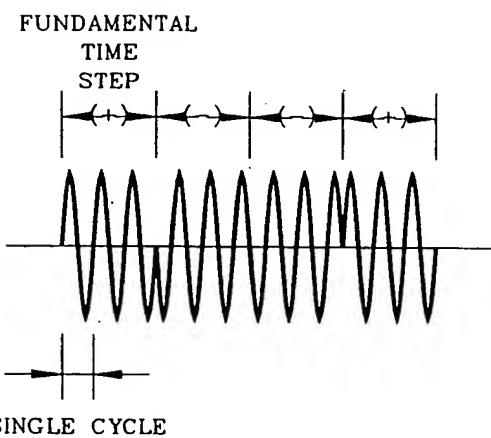
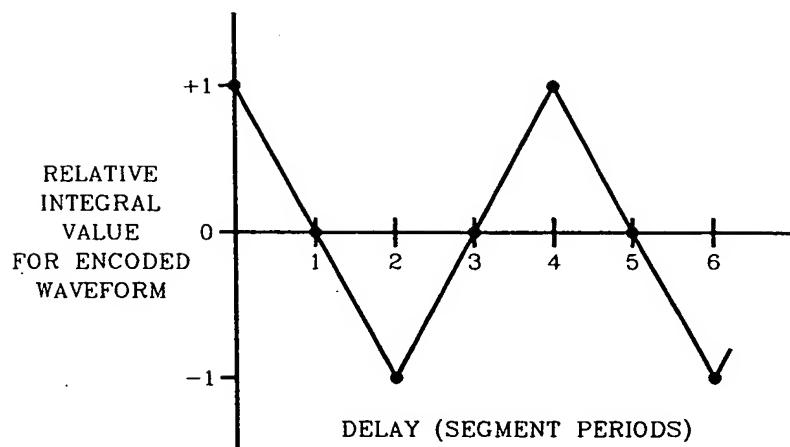


FIGURE 5-3



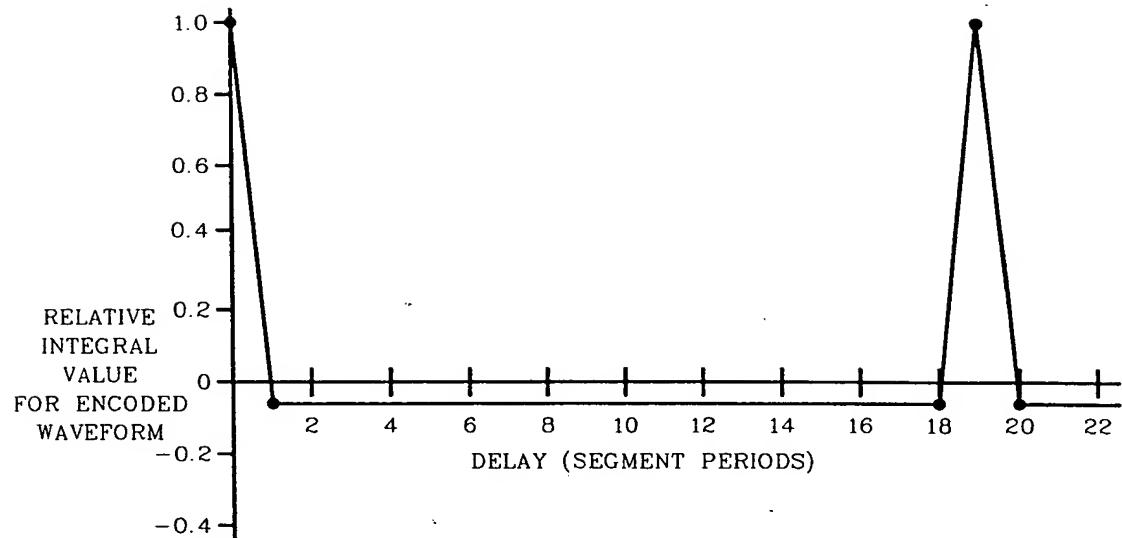
NOTE: AN INTEGER NUMBER OF CYCLES PER TIME STEP  
(3 IN THIS PATTERN)

FIGURE 6-1  
A 4 SEGMENT (+ - - +)  
TIME ENCODED WAVEFORM



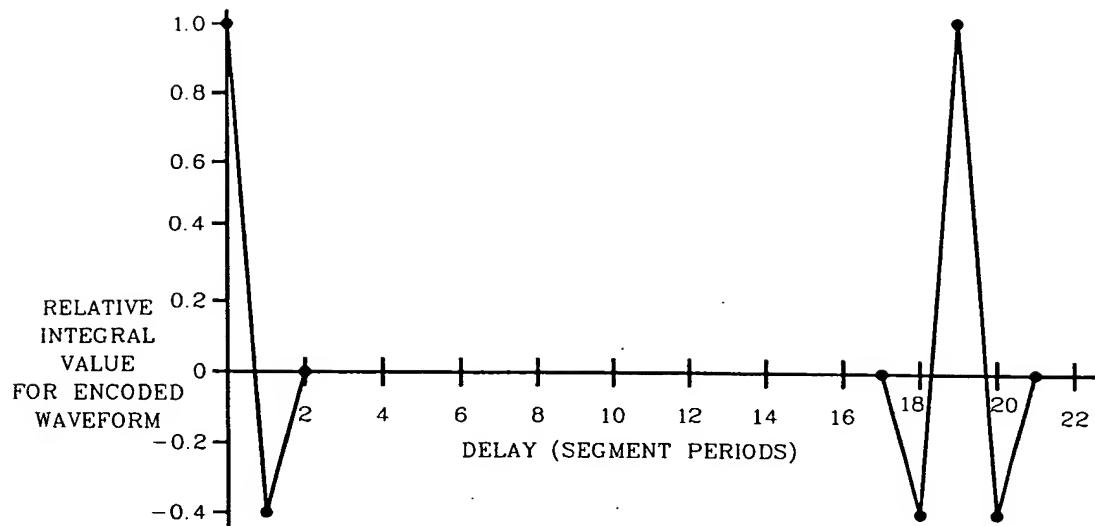
NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS ZERO

FIGURE 6-2  
CORRELATION OF THE 4 SEGMENT (+ - - +)  
ENCODED WAVEFORM WITH ITSELF



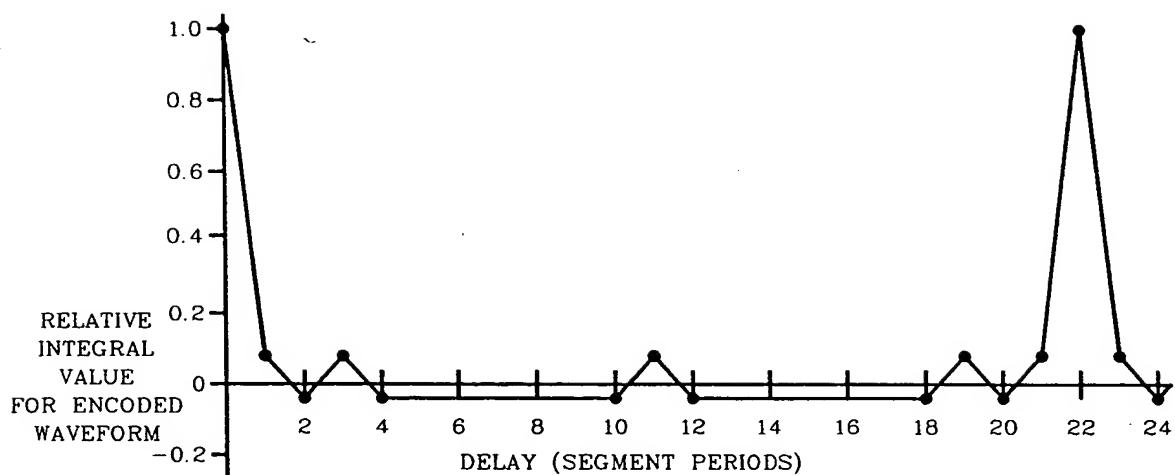
NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS 0.0526

FIGURE 6-3  
CORRELATION OF THE 19 SEGMENT  
(++++--++-++--+-+--)  
ENCODED WAVEFORM WITH ITSELF



NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS -0.1

FIGURE 6-4  
CORRELATION OF THE 20 SEGMENT  
(+---++--+---+-++-+-+--)  
ENCODED WAVEFORM WITH ITSELF



NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS ZERO

FIGURE 6-5  
CORRELATION OF THE 22 SEGMENT  
(++++---+---+-+++-++-)  
ENCODED WAVEFORM WITH ITSELF

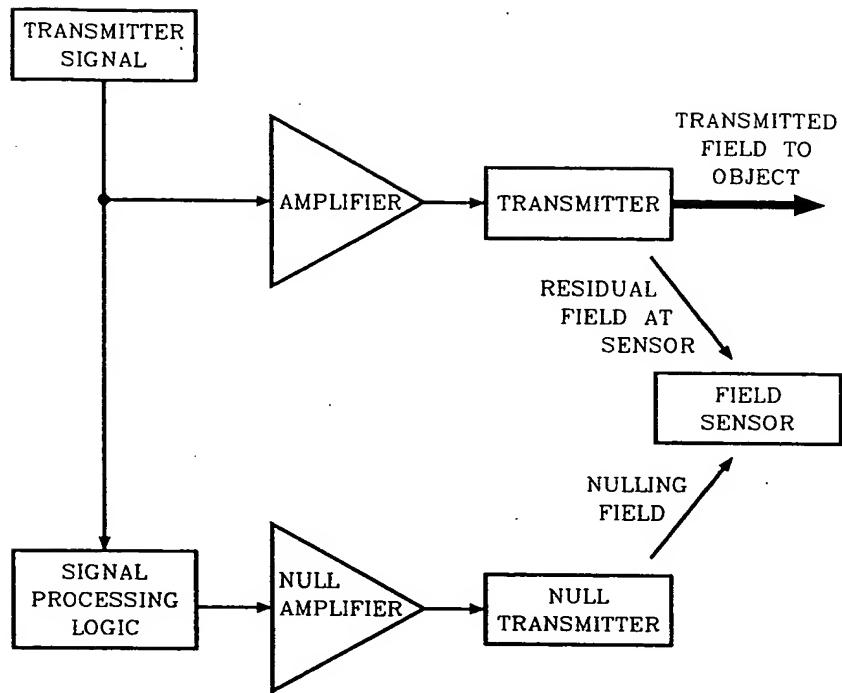


FIGURE 7-1  
LOCAL MAGNETIC FIELD GENERATION  
FOR RESIDUAL FIELD CANCELLATION